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Stanley Gregory

1926-2016

Ron Johnston

British geography teaching – in both schools and universities – was changed very substantially in the 1970s, involving a number of influential scholars, of whom one was Stanley Gregory (always known as Stan). The establishment of geography as a university discipline in the late nineteenth and early twentieth centuries was very largely a consequence of its recent introduction to the country's grammar and independent schools. A cadre of qualified teachers was then required, and university honours degree programmes were created to meet this need; their curricula to a considerable extent focused on material in the school syllabuses that those graduates would be required to teach. As their subject became more firmly established in the universities – itself a difficult process – so university geographers sought a clearly-demarcated niche as researchers within the academic division of labour. Until the 1970s, this focused very largely on people-environment interactions and the regional mosaics that reflected both the physical constraints (studied in foundational modules on, for example, geomorphology and climatology) plus human realisations of, and modifications to, the available potentials, producing myriad unique regions. (On the institutionalisation of British geography, see Johnston, 2003.)

A major change to this orientation was initiated in the United States in the 1950s and 1960s, which soon became known as the 'theoretical and quantitative revolutions', embracing significant changes in both approach – from the ideographic celebration of different regions to the nomothetic search for order in the landscape – and method – from field survey, mapping and descriptive accounts to data collection and mathematical and statistical analysis leading to hypothesis-testing and law-creation. These revolutions reached and were promoted in the United Kingdom within a decade, alongside parallel local developments (Johnston and Sidaway, 2016); they didn't totally change how geography was practised there – nor did they in North America – but their impact was very substantial, rapidly diffusing from a few centres through the university system and into the secondary schools.

In the historiography of those changes much emphasis is placed on the role of the Department of Geography at the University of Cambridge (see, for example, Barnes, 2008), where in particular Richard Chorley and Peter Haggett – both with strong North American connections (see Haggett, 1990, and Stoddart, 1997) – introduced novel substantive and methodological material to undergraduate and postgraduate students, with many of the latter taking those innovations with them to other universities where they obtained teaching posts (see, for example, the diffusion diagram in Haggett, 1990, 154). Chorley and Haggett also had a major influence on how the subject was practised in secondary schools, mainly through a series of summer schools for teachers held at Madingley Hall in the early- and mid-1960s and two major books that emanated from those events – *Frontiers in Geographical Teaching* and *Models in Geography* (Chorley and Haggett, 1965, 1967; Haggett, 2015). The importance of Chorley and Haggett, their students and associates is widely recognised in discussions of the changing scene then and with Haggett's move to Bristol in 1965 this was 'formalised' in a 'Cambridge-Bristol axis' as the bi-nodal source of the rapid diffusion of what some then termed the 'new geography' (Whitehand, 1970).

Crucial though these sources were to changes in how geography was practised and taught in the UK, they were not the sole origins (as Haggett, 2008, himself recognised). There were other, parallel and,

of course, increasingly intertwined, strands one of which, relatively little recognised since, had very few links to what was happening in North America. Gregory (1976e) identified three sources of the changes in the UK: one involved individuals who had either trained at or visited departments in North America where the 'revolutions' were being promoted; another contained individuals who had learned about quantitative methods elsewhere; and the third comprised a series of 'home-based' nodes. One of those separate nodes in the last category – or sources of an eddy, in Haggett's (2008) terminology – was located at the University of Liverpool, where Stan Gregory was an Assistant Lecturer/ Lecturer/Senior Lecturer/Reader for eighteen years (1950-1968), but its origins go back three decades earlier, as outlined here. This memoir outlines his career as a climatologist who realised the value of formal statistical analysis across both physical and human geography and who worked successfully for its incorporation within syllabuses at both university and secondary school levels within the United Kingdom.

Education, Life, Work

Stanley Gregory was born, on 28 February 1926, and raised in north London. At primary school there he won a scholarship at age 11 to a state grammar school, and chose the Polytechnic Secondary School in Upper Regent St in central London. The school was evacuated to Somerset at the onset of the Second World War and he spent much of the next five years there, mainly in the Minehead area, returning home during some of the vacations. He gained his School Certificate in 1941, with distinctions in Mathematics, English Grammar, History, Geography and General Science, and entered the sixth form, gaining his Higher School Certificate in Geography, English Literature, French and Latin (having been persuaded by a Classics master not to take-up his original choice of Geography, British Constitution, Statistics and Economics & Accountancy); he was awarded an Open Scholarship to Exeter University College.

He left school in July 1944 and in October was called-up into the forces, enlisting in the Royal Navy; after initial training in the Meteorological Service of the Fleet Air Arm he was posted to Evanton, Easter Ross, in northern Scotland, on VE Day in May 1945. Further training there fostered his interest in climatology – the field in which he specialised throughout his academic career; he had been scheduled at the end of that training to move to the Far East but VJ Day intervened and he served out the rest of his service in Scotland, preparing flight forecasts. While stationed there in July 1945 he met Marjorie, who was holidaying in the area with her family, on the bridge in nearby Alness; they were married on 28 July 1950.

On demobilisation he enrolled for a geography degree at King's College London, supported by an ex-serviceman's grant, rather than take up the scholarship at Exeter; his contemporaries and near-contemporaries included several others who had distinguished academic careers – including Eric Brown, Tony Chandler, Norman Graves, Basil Johnson and Clarence Kidson. On graduation in 1950, with a first class honours degree (he got first class marks for eight of the nine courses assessed in the final examinations), he enrolled for a Certificate in Education at the University of London Institute of Education, but just before his wedding applied for a post at the University of Liverpool that had been brought to his attention. After their honeymoon Marjorie and he set up house in London and he did three days of teaching practice at a school in Paddington. He then had an interview in Liverpool, was appointed to an assistant lectureship, and they moved north. He taught courses in meteorology and climatology (Robin Butlin – pers. comm. – remembers him as 'a very professional and talented communicator of whatever he was involved in'), whilst working towards an MA in 1952 and then, by published work (ten papers), a PhD in 1958.

Stan remained at the University of Liverpool for eighteen years, being promoted to Lecturer in 1953, Senior Lecturer in 1962, and Reader in 1966. He spent the academic year 1960-1961 as a Visiting

Lecturer in Geography at the University College of Sierra Leone (having just turned down a relatively well-paid post at the University of Winnipeg; at the end of his year in Sierra Leone he received an attractive offer to remain there as professor of geography, which for a short while he was minded to accept); he returned to West Africa in 1965, visiting universities in Ghana, Liberia, Nigeria and Sierra Leone. In 1968 he was appointed to a Chair in the Department of Geography at the University of Sheffield, replacing Alice Garnett.[1] He remained there for the rest of his career, taking early retirement in 1988. During those twenty years he served for two periods as Head of the Department of Geography (1971-74 and 1977-80) and one as Chairman (1985-87); he was Dean of the Faculty of Social Sciences (1978-80) and Pro-Vice-Chancellor (1980-84) and served on many university committees. (The official history of the university depicts him as 'well known for his forthright views': Mathers, 2005, 263.) He travelled widely during that time also, including lengthy visits to Canada (where he was a Commonwealth Visiting Fellow and Visiting Professor at the University of Ottawa in 1970 – returning there in 1973 to be awarded an Honorary Doctorate, DGeog – and visiting seventeen other institutions), Australia, South Africa, and India, plus many shorter visits (some as external examiner) to East, South and West Africa, Australia, India, Jamaica, Mauritius and China. Plans for more such visits, combining research and travel, after his retirement had to be abandoned because of Marjorie's ill-health. Stan cared for her until her death on 6 November 1997. He married Helga in 2006 and they travelled widely and often to most parts of the world until only weeks before his death on 8 April 2016.

Scientific Ideas and Geographical Thought

While an undergraduate in London, Stan took courses in climatology with Percy Crowe, very much a forgotten pioneer in British geography but one of the very first to promote the use of statistical methods (as against just statistical data) within its methodological armoury. Stan recognised this in the Preface to the first edition of his pioneering textbook *Statistical Methods and the Geographer*; 'The intricacies and essential characteristics of statistical methods were first introduced … [to me as a student] … by Professor P. R. Crowe' (Gregory, 1963a, ix). Stan was also taught at King's by William Balchin, a physical geographer with wide interests who had undertaken climatological research during the war (e.g. Balchin and Pye, 1947). Climatology then, and for some years after, was 'a cinderella science, languishing in the care of geography and looked down upon by the practitioners of meteorology' (Kates and Burton, 1986, xiii, quoting Hare and Sewell, 1986, 213). It was taught as a core module in the first years of most geography undergraduate degrees (in some cases by those with no qualifications in the discipline) but with specialist optional courses attracting very few takers. (David Unwin – pers. comm. – reports that in 1964-1965 such a course offered inter-collegiately to all final year geography undergraduates in the University of London – taught by two leading scholars in the field, Tony Chandler and Ken Hare – attracted only four students.)

Percy Crowe and climatological statistics

Percy Crowe read for the BSc(Econ) degree in geography at the London School of Economics in the early 1920s. With an interest in mathematics he took courses in statistics as well as geography, being attracted to climatology in part 'because of the scope it gave for statistical measurement' (Crowe, 1965, 2); that interest was enhanced by his work in the Meteorological Office during the Second World War before enlisting in the RAF. (Peter Lewis – pers. comm. – recalls Percy telling him that his quantitative expertise was used to improve shell-firing from battleships in mid-Atlantic.) He obtained an academic post at the University of Glasgow in 1925, moving to Queen Mary College in the University of London in 1947, and then as Professor and Head of Department at the University of

[1] The chair was advertised as one in Human Geography (Ron Waters had been appointed to a chair in physical geography in 1965) but Stan, clearly a physical geographer, was encouraged to apply and was then appointed because of the perceived relevance of his statistical work to all parts of the discipline.

Manchester in 1953. As Musk and Rodgers (1980) indicate, he wrote relatively little, but almost all of it – including his textbook *Concepts in Climatology* (Crowe, 1971) – was highly original although, as far as one can tell, it attracted little attention. He is not mentioned in Pacione's (2014) history of geography in Scotland (for neither his climatology and population geography papers – e.g. Crowe, 1927 – nor for his debate with Dickinson on 'Progress in geography': Crowe, 1938; Dickinson, 1938) and although his teaching is mentioned in Steel's (1987) collection of essays on British geography between 1919 and 1939 his research is not, nor is it covered in Atkinson's earlier survey (1980).

Crowe's first climatological paper appeared in 1933 – after he had spent two years in the United States. It was not only pioneering, it was so different from virtually everything being published by geographers then that its apparent almost total lack of impact is unsurprising. The fifth word in its title alone – 'The analysis of rainfall probability' – marked its uniqueness, although very little of its contents were about probability per se. It asked the question, 'When are there marked discontinuities in monthly rainfall amounts at European locations?', which he answered by deploying the inter-quartile range (IQR) of rainfall amounts at a station at either adjacent or near-adjacent pairs of months using data for a sequence of years; where those IQRs did not overlap he concluded there was strong evidence of a discontinuity. He applied this method to analysing a large number of stations in, first, the US Western Plains (Crowe, 1936), and then the south-eastern United States (Crowe, 1951b), not merely to describe the situation at the separate stations but also as a means of defining climatic regions – areas with different rainfall regimes: the latter paper was described as 'purely descriptive in character. Its object is to establish a regional classification of rainfall types on an objective basis … the work of a geographer seeking valid generalizations' (Crowe, 1951b, 71). An application to British data appeared in a paper presented to the Royal Meteorological Society, in which he criticised the use of means to summarise the regime at any station and promoted the study of regional contrasts through the use of IQRs (Crowe, 1940). Means were recognised as a 'compact descriptive summary of a complex body of observations' (p.285), but their deployment rested on an assumption that they represented an 'approximation to a relatively timeless "normal"' and raised questions whether differences between means (either between two stations or between years at the same station) were significantly different. Hence his analyses instead supplemented their employment with a technique 'especially suited to the analysis of long records of doubtful homogeneity, hitherto the bugbear of the statistical climatologist' (p.286) and contrary to the standard practice of assessing differences between means. Thus, for example, he identified a particular month as wetter than another if it 'has recorded more than half an inch in excess of the other during two-thirds or more of the years under review' (p. 289). In his conclusion he claimed only that 'the concept of regime has been given a new orientation' (p.309), an orientation that his student, Stan Gregory, followed in his own research a decade or so later.

In a period pre-electronic calculators let alone computers this was massively time-consuming work, as was his later major project on the trade winds. In this, too, the goal was to analyse data robustly (his wording was 'map objectively': Crowe, 1951a, 23) in order to identify 'regions' with different regimes – in this case of wind speed and direction. His final research papers were on evapotranspiration, in which he reduced complex measurement procedures to a straightforward equation (Crowe 1954, 1957).

Although he was a pioneer of some very substantial changes in geographical practices Crowe was not enamoured by what was taking place at the end of his career. His review of the first volume of *Progress in Geography* (Crowe, 1970) criticised most of the contents (notably the language). He hoped that Cox's paper on 'The voting decision in a spatial context' was 'not geography' whereas Gould's on 'Methodological developments since the fifties' was 'an exercise in non-communication in the very real sense that, if you can follow him, there is very little point in doing so and, if you cannot, you will emerge very little the wiser' (p. 347)! Two years earlier, a similarly biting review of

Models in Geography (Chorley and Haggett, 1967: the review – Crowe, 1968 – is published as by PRC and there can be no doubt that he was the author) claimed that 'a new faith is hardly likely to be attained by a frenzied search throughout the realms of physical and social science for gadgets which might conceivably be turned to geographical ends' (p. 423); whereas on the use of quantitative methods his opinion was that New Geography's adherents have 'an apparently unbounded confidence in the efficacy of "regression" and related statistical procedures' (p. 424).

Stanley Gregory: climatologist

These aspects of Crowe's work can be classified as descriptive climatology, set firmly within the regional paradigm that dominated geography at the time, though methodologically much more sophisticated than studies undertaken by his contemporaries. Stan Gregory built his own career in that mould, undertaking increasingly more sophisticated – and time-consuming (all of his early research was undertaken without the benefit of electronic calculators let alone computers) – means of describing spatial variations in climatic parameters, from which regional generalisations could be derived. His work, and that of most other geographer-climatologists in his and the subsequent generation, was almost entirely descriptive with little appreciation of statistical modelling and inferential methods.

His MA thesis (submitted in May 1952, some eighteen months after he took up his post in Liverpool) was entitled 'A delimitation of rainfall areas of southern England on the basis of the normal and the exceptional, 1900-1939'; the material was reworked in several of his early papers included in the collection submitted in 1958 for the degree of PhD under the title 'Studies in Pure and Applied Climatology'. (The data were obtained from the annual series *British Rainfall*, then available in hardcopy only but now in digital form: http://www.metoffice.gov.uk/learning/library/archive-hidden-treasures/british-rainfall.)

Before he began publishing his own research, however, Stan undertook a commission to produce an essay in descriptive climatology of the type that he intended to replace. Attendees at the annual meetings of the British Association for the Advancement of Science were provided, for much of the twentieth century, with a substantial book about the city and region where the meeting was being held – which in 1953 was Liverpool. Many of those volumes included a chapter on the local climate and Stan was asked by the editor of the Liverpool volume – his head of department, Wilfred Smith – to produce it. His approach – typical of his predecessors' – was to provide a descriptive overview of variations in temperature, precipitation, wind, sunshine and fog across the region, using data for selected stations, enabling him to categorise the area's climate as atypical of both western coastal areas and their bordering uplands, with its own internal variations 'between hill-foot and hill-top, between coast and inland, between lowland and upland, and between the rain-shadow area south of the Mersey and the area facing the Irish Sea, north of the Mersey' (Gregory, 1953a, 68). But the chapter did contain a forerunner of what his ongoing research was going to promote: the section on precipitation included a diagram showing monthly rainfall patterns over a thirty-year period at eight stations, and including – as he had learned from Crowe – the inter-quartile range of recordings in each month (p. 62).

Stan's first research paper, also published in 1953, was presented as extending standard methods of comparing rainfall patterns by establishing whether what was recorded at any station or larger area in any year was exceptionally wet, normal, or exceptionally dry (Gregory, 1953c): exceptionally wet years for the stations in southern England studied in his MA thesis were defined as those where the annual total exceeded the upper quartile by at least 10 per cent of the median, with a comparable definition for extremely dry years as less than the lower quartile by at least 10 per cent of the median, stressing that the median was a better indicator of the 'normal' than the mean. In his next

paper (Gregory, 1954a) he extended this analysis by using the distribution of exceptionally wet and dry years to define rainfall regions, areas with similar trends in their annual rainfall over the period 1900-1939. He then applied the method to Europe-wide data, identifying patterns of climatic change which meant that the boundaries of regions defined using the then standard procedures developed by Köppen shifted over time – such changes being partly a consequence of random fluctuations and partly of 'definite changes in climatic conditions' (Gregory, 1954c, 252).

Other papers in this series extended the study of rainfall variability to the whole of the British Isles (Gregory, 1955a) and a regionalisation was suggested using ten-year running means for over 200 stations (Gregory, 1956a). A change in regime was recorded if the difference between two decadal means was twice the standard deviation of the difference between all pairs of means (what he described as a 'sufficiently stringent statistical test' – p. 348). The definition of regions was less 'sophisticated', however; on examination of the graphs of running means 'several markedly different groups of graphs were readily distinguished' (p. 349), giving four major regions, three of which largely coincided with particular topographical regions. A final paper in the sequence (and in the PhD) introduced the use of probability in the mapping (Gregory, 1957a). Using data on the mean and standard deviation of rainfall amounts at each station he calculated and mapped, using the normal curve, the probability at each station of it receiving more or less than 20, 30, 40 or 50 inches of rain per year. These papers were characterised by a large number of maps. The Department of Geography at Liverpool, like many others at that time, had extensive cartographic facilities and some of its staff members were involved in cartographic teaching and research (Monkhouse and Wilkson, 1952). The second edition of that book (published in 1963) included a chapter entitled 'An introduction to numerical and mechanical techniques' which was revised for the third edition by Roger Barry (1971); its inclusion was justified by the authors' statement that 'During recent years statistical methods and procedures have assumed an important role in the practice of geography …and … the authors decided it was desirable to include a separate Appendix devoted to a comprehensive review of statistical methods in geography' (Monkhouse and Wilkinson, 1971, xiv), noting that 'the draft was critically reviewed by Dr. S. Gregory'. Barry was an undergraduate at Liverpool, before Stan introduced his statistical methods course; he was one of the few to take the final year optional course in climatology and Stan mentored his undergraduate thesis on climatic conditions at Scottish airports. He then did an MSc at McGill University before returning to Liverpool to continue the work begun there on vapour transport over Labrador-Ungava for a PhD under Stan's supervision, being the first geographer to take a computer programming course (see Barry, 2015).

Stan's descriptive analyses involving massive amounts of data manipulation and extensive mapping of various aspects of the British climate ended with the award of the PhD and his increasing interest in problems of water supply. But by then he was recognised as one of the country's leading descriptive climatologists and as such was invited to prepare the chapter on climate for the volume produced at the time of the 1964 International Geographical Congress, held in London (Gregory, 1964b). In this he set his portrayal in the context of the typical weather systems that affect the British Isles, and then drew on his earlier studies to identify variations in the length of the growing season (Gregory, 1954b), in mean annual rainfall (using the mean and coefficient of variation for the first time), and in seasonal rainfall fluctuations. He drew on Crowe's (1940) work on rainfall regimes – one of the few occasions in which he referred to that work – and concluded that 'regional diversity is as much a characteristic of British climates as is temporal fluctuation. Nevertheless, their treatment is scarcely appropriate in this work, which focuses attention on the British Isles as a whole' (p. 72). He returned to the subject two decades later, in an essay that reviewed various climatic regionalisations of the British Isles (in all of these studies, he covered the whole of the island of Ireland) and then presented an alternative view based on three criteria – the length of the growing season, rainfall magnitude, and rainfall seasonality (Gregory, 1976d): the regional

boundaries were the result of prior definition rather than as the outcome of inductive classification-regionalisation methods then becoming popular.

In the 1960s Stan began visiting Africa, collecting data that were used to extend the coverage of the type of work he was promoting. This is exemplified by a monograph on rainfall over Sierra Leone (Gregory, 1965a) and a long essay on rainfall over Moçambique, focusing on variations in its intensity using a range of measures at three temporal scales – annual, seasonal, and monthly – and illustrated by probability maps (Gregory, 1964c). Rainfall reliability was the subject of a further essay on Africa (Gregory, 1969a), with data from Ghana, Sierra Leone, Nigeria and Liberia as well as Moçambique used to illustrate his basic themes regarding the importance of studying variability in analyses of this basic resource for crop production and hence the need for its proper measurement. The final section is entitled 'Probability studies' and extends his earlier work on this topic with discussion of the use of standard errors.

Stan did little climatological research in the 1960s, but returned to it in the 1970s, with a further, but more diverse, series of studies of climatic fluctuations – especially rainfall deficits and drought (brought together in Gregory, 1986f) – and a growing interest in the wider issue of climatic change. In the former, he adopted methods of data reduction, classification and regionalisation, increasingly widely used in sections of human geography research by then and introduced to climatological studies by Perry (1970). In a first paper (Gregory, 1975a) he extended a technique of reducing a correlation matrix of rainfall at pairs of stations in Sierra Leone (Gregory, 1965a) using a maximum linkage procedure to classify them according to similarity in their rainfall totals: a matrix of correlations of rainfall amounts at 50 stations across the UK for the years 1881-1950 was reduced to three 'spatially coherent' regions, with five, three and four sub-regions respectively. He then applied a principal components factor analysis to the same data, identifying five coherent regions in the unrotated solution and four in the rotated.[2] In a further paper (Gregory, 1979), aimed at identifying periods of extreme wet and dry conditions, he explored the use of Fisher's exact test to establish the probability of a station having a sequence of 10 or 30 years with rainfall either greater or less than its median or comprising its 10 per cent wettest and driest years during the period. The cumulated component scores from a principal components analysis of those data were then deployed to identify wet and dry periods, at a set probability level. He had previously used some of that material using Fisher's exact test in his IBG Presidential address, to illustrate his contention (quoting Ezekiel and Fox, 1959, 477: Gregory, 1976, 393) that:

> Statistical analysis is not a substitute for careful thinking, technical knowledge, and skilled workmanship in research work: instead, it is an aid which may make that thought and skill even more productive of worthwhile results.

Outwith the UK, he used a similar approach to define 'regions of change' in the Sahel and then calculated the probabilities – using hypergeometric functions – of regions experiencing rainfall deficits over a given number of years (Gregory, 1982a, 1983b). A parallel exercise was undertaken for New South Wales (Gregory and Cooke, 1986g), exploring the use of various statistical functions to model the skewed distributions at a range of stations and mapping their distributions.

Many of the studies undertaken in later years of this final period of Stan's research career used a database that he compiled for Indian weather stations (Gregory, 1986h). By correlating trends in summer rainfall at individual stations and by regional subdivisions with an all-Indian average rainfall he identified areas that deviated substantially from the latter, and principal components analyses plus a classification algorithm were used to regionalise the country. He then identified the stations with the most extreme periods of drought – for example, according to years when rainfall was less than the median – which generated a further series of maps: much of western India had patterns

[2] I published a mild critique of that work at the time, which Stan supported (Johnston, 1981).

that largely conformed to the all-India average, whereas the country's northeast had the most distinctive separate patterns. A later evaluation concluded that there was a tendency for certain patterns associated with rainfall deficits to appear across western India in El Niño years, especially those with strong El Niño conditions (Gregory, 1988c). Those deficits were mapped in more detail elsewhere (Gregory and Parthasarathy, 1986i; Gregory, 1992b) and a method derived for establishing whether there was a consistent pattern within a prescribed distance of a particular station (Gregory, 1987a). A final paper (Gregory, 1989a) used principal components analysis with classification to identify a set of 29 macro-regions, which he considered better than either a single all-India summary or the larger number of micro-regions used by the Meteorological Service:

> [it] … retains much of the essence of the diversity whilst facilitating spatial comprehension by greater simplicity (p. 483).

Forty years after he graduated, Stan's work remained within the regional mould that dominated his student years; he had long since rejected regional geography,[3] but not the regional approach – which he was making more rigorous.

Stan summarised much of the Indian material in a paper for *The Geographical Journal*, in which he expressed his (relatively mild) scepticism about some of the arguments regarding climate change:

> There is a tendency at present to see all and any increases in extreme climatic events as indicating the impact of the 'greenhouse effect', due to anthropogenic carbon dioxide and related gases in the atmosphere. It is clear from the record discussed here [for the period 1871-1985] that over the drier areas of India there have been periods within the past century or more when drought frequencies have been markedly higher than in recent years, although individual recent droughts may have been intense ones in some areas. (Gregory, 1989b, 333)

He had previously argued that drought, famine and desertification should not be treated as synonyms, and that full appreciation of the climatology of drought was needed as a foundation for developing policies aimed at ameliorating its adverse effects on environments and human life (Gregory, 1986f); his discussion of those 'basic ideas and concepts' took him further into causation – i.e. into meteorology – than had characterised much of his climatological writing.

Stan's final research paper was also on climate change. He noted that most discussions of warming were at the global or macro-regional scale but that 'climatic conditions at detailed locations may well differ, perhaps markedly, from these overgeneralised tendencies … [although] it is this detailed scale that probably most concerns even the informed individual' (Gregory, 1993, 241). Answers to questions about the local experience 'will not in itself say anything about enhanced global warming' let alone provide evidence of anthropogenic causation, but exploration of local data sets could be a valuable school exercise (the paper was published in *Geography*). So he assembled a data set comprising temperature and precipitation records for one station in Sheffield and using his preferred approach – 'data inspection, tabulation, graphical plots and simple statistical methods' (p. 241) – explored whether there was convincing evidence of statistically-significant climatic change there, concluding that the evidence was 'slight … the occurrence of above or below average conditions, and of more extreme events within these, rarely differ markedly from random' (p. 249). No more general conclusions were drawn; Stan remained a mild sceptic for the next two decades, but did no more research. For the rest of his life he did geography in another way – travelling the world.

The geography of water resources

[3] When I was interviewed for a Chair at Sheffield in 1973 Stan made clear to me in discussion that he considered one of the achievements of his first five years there was removing the predominance of regional courses in the final year of the undergraduate degree.

The title of Stan's PhD, 'Studies in pure and applied climatology', indicated that he did not see the presentation of climatic patterns as an end in itself. Indeed, this is hinted at in the introduction and conclusion to one of his first papers, when he suggests that the identification of regions 'throughout which fluctuations in rainfall amount are relatively similar for all stations … may yield results which will be of help in any consideration of the numerous problems of water supply' (Gregory, 1954a, 610). And in his paper on rainfall regions he noted that with changes in regional rainfall regimes 'there must also have been changes in the rate and volume of river flow and discharge, and changes in the rate and degree of erosion and deposition' (Gregory, 1956a, 353). This appreciation was set within a, then-traditional, view of geography's raison d'être: 'The concept of regional definition is probably one which springs more readily to the mind of a geographer than to that of most other workers in the field of rainfall studies. Once defined, regional differences will also increase our knowledge and appreciation of such problems as those of urban water supply, of crop yields and of the expansion or contraction of agricultural activities, especially in marginal areas' (p. 346).

This potential applied value of his rainfall studies was realised in Stan's paper presented as part of a symposium on 'Climatology applied in the service of man' at the 1956 meeting of the British Association organised in conjunction with Austin Miller's (1956) presidential address on 'The use and misuse of climatic resources', in which he averred that 'it is generally held that we have plenty of water; but its distribution is certainly not the best that could be designed and its reliability in place and time leaves much to be desired' (p. 62). Stan took up this cause (Gregory, 1957b), identifying the types of map that were needed to establish the normal situation but arguing that insufficient had been done to take monthly and seasonal fluctuations into account, especially those that may result in water deficits. Further, these had to be set in the context of the different ways in which water is obtained – from surface supplies (reservoirs, for example), underground supplies, and extraction from rivers, the reliability of each requiring different rainfall data. To illustrate the issues, he presented a map showing the boundaries of the numerous separate water authorities in northwest England and the main water sources on which they draw; in general the hill areas relied on reservoirs and other upland sources (which were substantially under-utilised: Gregory, 1958c) while the lowland areas relied on underground sources – except for the large cities that drew water from distant upland sources, also supplying some neighbouring authorities. The 'geographical climatologist', he concluded, could play a role in gaining a greater appreciation of the links between rainfall patterns and the increased demands for water.

This introductory descriptive approach to identifying the extent of the issue was followed up by a paper in which he mapped the geography of water supply authorities for the whole of England and Wales (Gregory, 1957c) – there were over one thousand of them at the time, in what he termed an 'essentially haphazard and piece-meal' pattern forming 'the most fragmented and disjointed of all the public supply services' (p. 145), a situation that was unable to cope with the increasing demand for water, especially at times of relative climatic extremes. Rationalisation was needed, as clearly illustrated by his detailed maps of the undertakings and how they obtained water, relative to the geography of water availability of various types (also mapped) – with a national plan and regional grids, if not a national grid, installed to ensure equitable provisions across the country. This overview was extended with detailed studies of the upland sources, notably to the country's conurbations (Gregory, 1958a, 1958b), and with a comparative study of the situation in the Benelux countries (Gregory, 1959b).

The applied nature of this work was exemplified in a contribution to the sequence of Anglo-Polish seminars on applied geography, co-sponsored by the IBG at the time to improve contacts when international communication across the Iron Curtain was difficult. Focusing on Lancashire alone, Stan illustrated how the means of obtaining water had changed over time, with particular reference to the recent reorganisation of the number and scale of water authorities (Gregory, 1964a). The

pattern of flows from sources to consumers and thence, via sewers and other outflows, into the region's rivers was far from rational, however. At the end of the 1960s, he concluded that the administrative reorganisation had created an infrastructure fit for the purpose of delivering increasing volumes of water to the growing range and intensity of demands, but was of the opinion that new options for extending the country's water supply were needed, of which he identified two – desalination and coastal barrages (Gregory, 1969b).

Statistical methods

Stan's early research focused on the formal analysis of climatic data, which also characterised his climatological teaching that, as was common then, attracted few students for optional courses (Ian Masser – pers. comm. – reports that he was one of only two students who took Stan's final-year climatology option in the late 1950s). But interactions with colleagues convinced him that the need for the rigorous analysis of statistical data applied more widely across geography and, encouraged by his head of department, Robert Steel (see Gregory, 1963a, ix), he introduced a second-year practical course on statistical analysis for all geography undergraduates. In this he was particularly influenced by Andrew Learmonth, a medical geographer who had served in the Royal Army Medical Corps during the Second World War; after obtaining degrees at Edinburgh he was appointed to the Liverpool geography department in 1955, and in 1956 seconded to work on a statistical cartography programme at the Indian Statistical Institute in Bangalore (on his career, see the essays in McGlashan and Blunden, 1983). Stan recognised Learmonth's importance to him in the preface to the first edition of his text book: it was to him 'to whom the greatest debt is owed, for his unfailing willingness to discuss and constructively criticize my efforts, for his persistence in exhorting me to proceed with the work, and for invaluable advice and assistance' (Gregory, 1963a, ix). Also present in the department and supportive were Mansell Prothero, another medical geographer, and Stan's close friend Dick Lawton, an historical geographer who worked on nineteenth century population changes (see Pooley, 2013); so certain was he of the relevance of the methods Stan was promoting to human geography in general that he attended the course in its first year, convincing some of the sceptical students alongside him. (To Robin Butlin this was typical of the camaraderie and collegiality that characterised the Liverpool department then.) The course – at both Liverpool (Peter Taylor, pers. comm.) and later at Sheffield – was not universally popular, however; Paul Curran (pers. comm.) reports that there was 'considerable moaning' among some students on Stan's introductory course at Sheffield in the early 1970s, who claimed that they wanted to study geography, not statistics. In response, Stan used several lectures to stress that the course would enable students to appreciate and understand recent research literature in geography, they could well need the methods for their own dissertations, and would develop a skill that could be important for future careers. Interestingly, by the mid-1970s an introductory course in statistics was required of all first-year students in the Sheffield Faculty of Social Sciences: it was taught by staff from the Department of Probability and Statistics, successive heads of the department claiming that only they were qualified to do so, but using Stan's book as the text for practical classes taught by Department of Geography staff.

First given in 1957, that introductory course stimulated many to apply statistical methods in their own work (Ian Masser – pers. comm. – reported that he was so enthused that he joined the Royal Meteorological Society). But it soon had a much wider impact when it became the core of Stan's pioneering textbook, *Statistical Methods and the Geographer*; the first edition – the first text on statistics for geographers, by a geographer – appeared in 1963, with three subsequent, substantially updated and extended editions, the last appearing in 1978. Based on a full and detailed appreciation of the methods presented, because Stan had undertaken a comprehensive period of self-education while consulting various experts in Liverpool (such as Robin Plackett, later a professor at Newcastle; he also acknowledges the help of David Bartholomew, then at the University of Keele and later at

the London School of Economics, for help in setting 'the pattern of the book'), the book was written in an easily accessible form with many worked examples. It was the 'bible' for many undergraduate cohorts over the next two decades and the foundation on which more advanced work was based: in Peter Haggett's words (pers. comm.), with Stan's book 'the ice had been broken and other convoys could move down the channel he created'. Writing thirty years after the first edition appeared, Clarke (1994, 212) noted that it 'reads remarkably well' and contained 'a number of messages still pertinent to the modern undergraduate student desperately trying to get to grips with statistical analysis'.

Substantial changes were introduced over the subsequent three editions, but the basic goal remained unaltered – 'to assist in the learning and appreciation of the initial stages of statistical manipulation, as geographers commence their training in this field … although for the subject at large the relevance and application of quantitative methods to geography is now commonplace (if far from universal!), for each new intending geographer it is still as confusing and difficult as it was two decades ago. Statistical methods and the geographer still need an effective interface, and it is hoped that this book can continue to satisfy this need' (Gregory, 1978a, xiii). But Stan did not extend the book far into what at the time were considered 'more advanced' methods – notably the rapidly expanding work on spatial statistics (spatial autocorrelation, for example, was mentioned in just a single paragraph in the final – 1978a – edition); his book remained a foundational volume.

In many ways Stan's strongest – and broadest – proselytization was made in a short paper based on his presentation at a colloquium at the University of Ottawa when he held a visiting fellowship there in 1970. As he put it, the shift was much more than methodological 'and far more critical than the initial superficial view might suggest' (Gregory, 1971b, 25); it raised a question of 'one's basic philosophy, which is then reflected in what one believes one is ultimately trying to do' – methodological changes followed from those goals. The '*ultimate* purpose of geographical enquiry is to generate theory (and perhaps, if one is fortunate, laws)' (p. 29: his emphasis), through hypothesis testing – presented as 'the normal processes of analytical reasoning' (p.27) or 'thinking according to a certain internally-coherent logic' (p.30). He thus summarised the advantages of the quantitative approach (pp. 32-33) as:

> [a] system of formalized logic, coupled with the related techniques … [that] focuses attention on the generalization, in terms of hypothesis and theory, rather than on the particular … [which deploys a] universality of .. approach, transgressing languages, different disciplines, and linking the various branches of geography … [that] can help remove the vagueness and the imprecision that has characterised much of geography in the past in … a discipline which is based on field-data … [for which] the quantitative approach and techniques provide our nearest approximation to experimental verification of our conclusions …

and concluded that

> it has not been maintained that if one has used quantitative techniques and the quantitative approach that one is therefore bound to be right – what has been maintained, however, is that if one has not used them, then one will never know how wrong one may be!

In this statement – much more than in his textbook – Stan allied himself with the wider 'theoretical' revolution advanced in the UK by Haggett (1965), Harvey (1969) and others. In a panel discussion at the end of the colloquium, Stan was at pains to stress that he never claimed that quantitative methods were objective whereas all others were subjective, nor that their use involved 'rational reasoning': his case was simply that they 'lend themselves to a less ambiguous form of statement that may represent a type of formalised logic to which people know how to react' (Gregory, 1971b, 194).

Impact and Spread of Ideas

Outside the departments at Liverpool and Sheffield Stan did much institutionally to promote his specialist sub-discipline – climatology. With his former student colleague Tony Chandler in 1971 he co-founded and from 1973 to 1975 co-chaired the Climatology Discussion Group (renamed the Association of British Climatologists) that was initially affiliated with the Institute of British Geographers but then shifted to the Royal Meteorological Society, and he was the founding editor of the (later *International*) *Journal of Climatology*, serving from 1981 to 1986. As one of the country's senior climatologists, he served on a Natural Environment Research Council Study Group on Climatology (1972-1973) and was subsequently appointed to its Aquatic and Atmospheric Sciences Committee (1976-1979). In 1984 he was the founding chairman of the International Geographical Union's Study Group on Recent Climatic Change, which in 1988 became its Commission on Climatology; he was made an emeritus member in 1998, when he attended its meetings in Portugal, and the last academic conference he attended was its meetings in China and South Korea in 2000.

But Stan's major impact on geographical practice was much wider, not only building on the success of his Liverpool teaching and textbook in promoting the use of statistical methods within geography but also through the research and teaching of the group of like-minded colleagues working across human and physical geography appointed during his first decade at Sheffield, plus the postgraduates he and they supervised. He fervently believed in the importance of rigorous statistical analysis throughout the discipline and was centrally involved in its promotion in three ways. He was one of quantitative geography's most successful revolutionaries and disseminators.

Statistical methods in geographical research. In the early 1960s the Institute of British Geographers inaugurated the first of its highly successful Study Groups as a means of bringing together workers with cognate interests through focused meetings both during the Institute's annual conferences and on separate occasions. In 1964 Barry Garner, recently appointed as an assistant lecturer at Leeds with a PhD from Northwestern University, convened a meeting at Leeds of some 30-35 interested in using quantitative methods to which Stan – whose book had recently been published and who was one of the very few 'establishment' geographers with such an interest – was invited to attend. What was initially called the Statistical Methods Study Group was founded then, with Stan chairing it for its first four years (Gregory, 1976e) and Barry Garner as secretary. Although it met during the IBG's annual conferences the group did not initially affiliate with it, however; Stan – then a member of IBG's Council – believed that to do so would be the 'kiss of death' because of the opposition to quantitative work among the discipline's senior members.[4] Affiliation followed in 1968, when Stan ceased to chair the Group, being succeeded by Brian Robson; in the preceding four years, group meetings (in some cases resulting in 'occasional publications') did much to create a body of researchers who shared their growing appreciation of the use, abuse and potential of quantitative methods across physical and human geography – a group that remains large and vibrant fifty years later.

Stan reflected on the Study Group's early years in his retrospective essay published in the Institute of British Geographers' *Transactions'* 50th anniversary issue (Gregory, 1983b), noting that it had two original functions 'of equal importance – encouraging and facilitating research developments, and educating as much of the profession as possible (staff and students) to try to avoid too gross a

[4] Stan's election as an IBG Councillor in 1963 illustrated his 'revolutionary role'. Until the 1970s the Institute's Officers nominated a slate of three candidates to fill the three rolling vacancies for a three-year term on its Council. Nominations were invited from the floor at the AGM but there were usually none and the three went through 'on the nod'. In 1963, however, there was such a nomination, an election was held and the candidate from the floor – Stan – emerged victorious! (This comment is largely based on personal recollection – it was the first IBG conference I ever attended – and I am grateful to Catherine Souch of the Royal Geographical Society for digging out the relevant Minutes so that I could check my memory.)

dichotomy between the "quantifiers" and the "rest"' (p.85). He believed it had been successful, but that its problems were getting more difficult with time – 'the needs of the research frontier increase, yet the numeracy input from school is not necessarily greater than it was'. To tackle that deficiency, Stan carried his 'revolutionary fervour' into school geography.

An example of Stan promoting the use of quantitative methods across the discipline was provided in his Presidential address to the Institute of British Geographers. The doyen of British historical geographers at the time, Clifford Darby, had claimed from his work on the Domesday Book returns that 'Generally speaking, the greater the number of plough-teams and men on an estate, the higher its value, but it is impossible to discern any constant relationship' (Darby and Campbell, 1962; quoted in Gregory, 1976e, 393). Stan took this as a challenge and extracted two data sets from those assembled by Darby and his collaborators on the Domesday project. With the first, a simple regression model accounted for 73 per cent of the variance in the value of plough-team returns; in the second, his simple regression accounted for 97 per cent (a result that he questioned – because of collinearity among the variables – but which nevertheless made his point!)

Stan also played an important part in the development of quantitative work in Francophone Canada and Europe. While at the University of Ottawa in 1970 he met Jean-Bernard Racine and spent much time with him and his students promoting quantitative analysis. Racine organised a colloquium there on the topic, which was attended by other visitors at Ottawa (Elisabeth Lichtenberger of the University of Vienna; Jean Pelletier of the Université de Lyon; and Alfred Jahn of the University of Wroclaw), plus Denise Pumain from Université de Paris 1 (la Sorbonne) and Jean Labasse from the Institut des Études politiques at the Université de Paris. Racine moved to Lausanne in Switzerland in 1973 and was involved in the Geopoint seminars organised in Geneva and elsewhere by the Groupe du Pont, some of which Stan attended (see Cuyala, 2016): as Racine expresses it (pers. comm.) '…a lot of geographers now professors at universities in Switzerland, in France, in Italy, and in Belgium, in Romania, in Algeria, in Tunisia are linked to my early contacts with Stan'. (Interestingly, Stan's textbook was not translated into French, only Polish and Bahasa Malay.)

Teaching statistical methods in schools. In his history of the Geographical Association (GA), founded in 1903 to promote geographical teaching at all levels in Great Britain, Balchin (1993, 53) identified the impact of the 'quantitative revolution' as a 'greater danger' to the Association than some other contemporary changes because it was by then (the mid-1960s) beginning to affect geography teachers in schools; 'Sensing another "new geography" quantitative techniques were enthusiastically taken up by many younger teachers but were viewed critically by the "establishment"'. The Association responded to this in 1967 by setting up a Committee on the Role of Models and Quantitative Techniques in Geographical Teaching, a move – as Balchin saw it – to 'bring back the "revolutionaries" into the fold [by seeking to] … resolve what had become a somewhat heated debate' (see also Goodson, 1988, 166-176). After consultation the then Secretary of the Association, Alice Garnett, invited Stan to chair the committee. Stan later reported that the pressure came from 'a number of school teachers who had been stimulated by the first series of Madingley Lectures at Cambridge' (Gregory, 1983b, 85); Walford (2001, 161-162) records that they initially created a London Schools Geographical Group (LSGG) which was 'first challenged, but then quickly embraced' by the GA – what he later characterised as 'successfully infiltrating' that organisation. Alice Garnett was herself sceptical about the 'quantitative revolution' but saw the need to come to terms with it. In her presidential address to the Association she accepted that 'the subject has entered a phase wherein quantitative reasoning based on numeracy is rightly regarded as essential to study' (Garnett, 1969, p.390) but added that 'We must learn to assess critically their worth in the context of our subject and to use them with real understanding lest we do no more than veneer our geographical teaching with a seemingly erudite mathematical jargon that in fact has little or no value because it is not applied with full perception. Indeed, before we even attempt to use the new

methods it is of paramount importance that we first learn to evaluate critically statistical source material that we propose to use…'. Stan was appointed Joint Honorary Secretary of the Geographical Association in 1968 (replacing Alice Garnett) and resigned as the committee's chair, being replaced by Dick Chorley who in turn was replaced in 1969 by a 'Madingley-trained teacher', Brian Fitzgerald.

As its title indicates, the Committee's brief was much wider than quantitative techniques alone, and incorporated the 'model-based approach' characteristic of the Cambridge developments – hence Dick Chorley and Peter Haggett also being appointed to the committee. Chorley (1969) outlined its work in the opening paper in a special issue of the Association's journal, *Geography*, focused on its activities. One of its first actions was a questionnaire survey to gauge schoolteachers' reactions to what he termed 'the explosive and sometimes confused state of affairs on the research frontiers of geography' (p.1). The results were analysed in detail in a separate paper by Stan (Gregory, 1969c), highlighting a major division within the profession on the desirability of introducing 'models and quantitative techniques' into school curricula. In summarising those views, however, Stan expressed his own firm commitment that 'geography has reached its own particular Rubicon. To refuse to cross it could cut us off from contemporary scientific thought for many decades to come. To make the positive move to re-fashion geography into a subject fit for the twenty-first century … is both a challenge to the adventurous and a duty for all geographers who care for their subject' (Gregory, 1969c, 10) – adding that it was incumbent on those (apparently 'still' a majority) who did not believe in the 'models and quantification' approach to bring forward an alternative scenario 'to guide the future evolution of our subject along yet more fruitful and stimulating lines'. Those views can be appreciated in papers by Crisp (1969), Walford (1969) and Thomas (1970): the latter claimed that 'recent changes in the methodology of university geography primarily reflect a desire for more effective geographical research rather than a desire for more effective geographical teaching. Accordingly, it does not automatically follow that innovations which have been incorporated into university geography should necessarily be incorporated into geography at school level, as the basic concern of the latter must be the education of the child rather than the further development of geography as an academic discipline' (pp.277-278). In his report on another survey (contemporaneous to that reported by Stan), Hore (1973, p. 137) notes that the major problem in developing the 'new geography' in schools lay not with the students but rather with the teachers: 'the children … appeared to take things in their stride' but 'many teachers are simply unhappy, particularly with the quantitative side of the subject'.

Much of the Committee's work over more than a decade of activity involved facilitating interaction among local groups (initially termed 'cells') of teachers interested in developing games, models and exercises in the 'new geography' (with – as Walford, 2001, 161-162, describes it – some of those materials being seen by publishers and their authors encouraged to develop them into textbooks: e.g. Everson and Fitzgerald, 1969); a regular bulletin provided information on the groups' activities and was supplemented by a published bibliography of developments in geographical teaching. With support from the Department of Education and Science and the IBG's Quantitative Methods Study Group, it arranged courses and conferences for teachers at several locations (Gregory, 1983b, 85; Walford, 2001, 182: see also Walford 1973, 1981 and 1991, which report on later meetings), and a range of sessions at the Geographical Association's annual conferences. Its Computer Working Party evolved into the Geographical Association Package Exchange (GAPE), organised from the University of Loughborough by David Walker as a means of sharing software to be used in geographical teaching.

Changing the General Certificate of Education syllabuses. The fifth item in the Standing Committee's terms of reference was 'To encourage publishers and examiners to consider ways in which they can help the development and growth of the subject along conceptual and quantitative lines', which Chorley (1969, p.3) considered 'the most important' because 'in the long run the only way in which

new approaches and techniques can be adopted in the preparation of candidates is to have them as part of the material to be examined'. Despite some changes – mainly at 'A' level, an examination taken at age 18 and used as the main indicator of a student's potential as a university undergraduate – enough was not being done and he feared that 'geography may be losing many of the potentially more able students to subjects which are presented in a more intellectually challenging manner at school level'.

Stan rose to the challenge. In 1969 he was appointed as one of the University of Sheffield's members of the Northern Universities' Joint Matriculation Board (JMB). Established in 1903 to produce common entrance examinations for five 'northern' universities, the JMB's syllabuses were adopted by a large number of schools in England, Wales and Northern Ireland, Garnett (1969, 399) noting the 'dominant control … that examination boards exert on the ultimate work of the teaching profession (and even on the pattern of textbook writing)'; it became part of the Northern Examinations and Assessment Board in 1992. In 1970 he became chairman of its geography subject committee, which over the next five years introduced a new 'A'-level syllabus focused on the 'new geography', delivered in large part by a group of enthusiastic teachers (some of whom had attended the Madingley Hall courses) who then designed a new format for the external examinations – largely taken by would-be university entrants. Stan made no specific claim regarding the important role he played in these changes. Along with parallel changes by other boards and a range of innovative syllabuses funded by a number of bodies (Walford, 2001), they cemented the importance of model-based teaching and quantitative techniques in post-compulsory school education – although in the early 1980s a 'rearguard' action from some teachers led the JMB to introduce an optional further syllabus reflecting a more 'traditional' approach.

For Stan, a major reason for changing school curricula and public examination syllabi was to influence the attitudes and prior knowledge/expectations of potential university students. He did not want to scare them off,[5] however, as he made clear in a chapter written for that audience: 'The full rigour of mathematical technique appears only in more advanced geographical research and theoretical studies. At undergraduate level, and indeed in a large proportion of geographical work, the requisite mathematical and statistical understanding is no more than can reasonably be expected from any educated individual in the contemporary world' (Gregory, 1970b, 44). He argued that two of the traditional geographical questions – 'where?' and 'what?' – could well be answered with the geographer's established (mathematical!) tool, the map. But maps were becoming increasingly inadequate for addressing the 'why?' questions, and scientific procedures were needed to establish the validity of any conclusions being drawn; 'Informal (if informed) guesswork … must be replaced by the testing of hypotheses in terms of spatial probability, and instead it must be replaced by the mathematical manipulation of data into conceptual frameworks that allow such testing to be carried out' (p.46). Geographical numeracy is thus essential to research that will 'only be of real value if the degree of validity of the findings can be clearly specified and if they are presented in such a way that policy decisions can be based on them. Both of these require findings to be presented in quantitative terms …' (p. 47). In support he quoted Morrison (in Thruelsen and Kobler, 1963) that 'the rise of statistical prediction, of probability, is perhaps the most characteristic of all the developments in twentieth-century science' to advance his cause that 'For geography, following this path eliminates the need for determinism, and allows probabilism to discard its subjective guesswork' (p.48). Thus, his final credo, 'for the geographer of the future … numeracy is a fundamental requirement' (p.53), and students intending to study the discipline at university should be prepared for that. He conveyed the same message in an essay aimed at those already at – or en

[5] That this was happening is exemplified by my own experience: I was applying to universities in 1958 and my geography teacher (an Aberystwyth graduate) advised me not to apply to Liverpool because the approach there was 'too mathematical'.

route to – university (Gregory, 1992a), that 'thinking statistically' was needed across much of geography, and it involved a probabilistic approach

A success story?

Chorley (1969, 4) concluded his paper on the Standing Committee by noting that 'it is only when geographers recognize that the existence of a separate Committee of this sort is unnecessary that its work can really begin'; it was wound up in the late 1970s, by when geography teaching throughout the British educational system had been very substantially changed. Indeed Stan claimed that without the two pressure groups – the IBG Study Group and the GA Committee – the, to him 'needed', changes in school geography 'may well have taken much longer to achieve – to the detriment of developments in higher education' (Gregory, 1983b, 85).

By 1978 Stan claimed – as always, entirely modestly as if he had played no major part in what had happened – that 'we now have the incorporation of statistical methodology as part of the training of geographers in all areas of higher education – universities, polytechnics, colleges of education and institutes of higher education' (Gregory, 1978a, 23). He considered this a vital situation for two reasons: the need for students to be able to read and appreciate the recent research literature and to develop technical competence to conduct their own investigations using the relevant methodologies. For undergraduates, the primary aim should be 'an ability to understand what the method does to data, and therefore what the results mean' (p.26) – ability to use the methods, increasingly through software packages, was of lesser importance; postgraduates would need more detailed training, otherwise methods could be wrongly used and their results misunderstood, but that had to be built on an ability for 'the current literature to be read intelligently and critically' (p.26). Such teaching was crucial to Stan's whole outlook: as he told the IBG in his presidential address, 'it is this very teaching, at both undergraduate and graduate level, that conditions the present health of our subject and its future growth' (Gregory, 1976e, 399).

The practice of geography changed throughout the British educational system in the 1970s, therefore, with the introduction of, among other things, the widespread teaching of statistical techniques for the analysis of an increasing range of available quantitative data. Stan Gregory was a major generator of that change, working alongside not only Chorley and Haggett and their followers at Cambridge and Bristol but also, increasingly, a number of other pioneers; the diffusion was from a series of nodes. (Another early centre was the University of Nottingham, where Cole and King – 1968 – produced a textbook based on their teaching of quantitative methods; see also Cole's, 1969, case for quantitative as against verbal description.)

This set of changes was the last for a number of years in which what was taught in the country's schools was significantly influenced by the academic community. Academic geography, especially human geography, has changed very markedly since the 1970s. There have been no revolutions involving existing approaches being entirely removed – quantitative analysis is still widely practised, despite some attempts to write it out (Johnston, 2006: Johnston et al., 2014a, 2014b) – but a wide range of others has been added to the disciplinary portfolio (Creswell, 2014; Couper, 2015; Johnston and Sidaway, 2016) what Walford and Haggett (1995) intriguingly refer to as the academic discipline's 'intellectual exfoliation'. But there has been little movement until recently to incorporate these into school curricula – perhaps reflecting further on Thomas's (1970) claim on the irrelevance of 'new geographies' to the general education within which school curricula are set. Academic geographers were involved through the main learned societies (the GA and the RGS-IBG) in defending geography's position within the national curriculum from the late 1980s on (Rawling 2001), but there was little pressure to change the syllabus. Then, in 2013, an A-level Content Advisory Board (ALCAB) reviewed of a range of syllabuses, including geography. Its geography panel,

predominantly university academics, recommended a broadening of the syllabus incorporating some of the approaches added since the 1970s, but retaining quantitative work.[6]

Conclusions

Stan Gregory's academic career had three main phases. In the first, set in the regional paradigm that dominated geography in the first half of the twentieth century and which he never fully rejected, he developed his skills as a descriptive climatologist, intent on making its work more scientifically rigorous through the application of statistical methods he had been introduced to as an undergraduate. As he established his reputation for that approach, he became convinced that those methods were relevant to a wide range of studies across virtually the entire corpus of work undertaken at that time by geographers – both physical and human; he argued strongly for the development of scientific thinking in the latter as well as the former in his presidential address to the Geographical Association (Gregory, 1978c). Promoting that cause both locally, to the students that he taught, and more widely through the discipline's institutional architecture, occupied much of the second phase of his career, during which he also played major administrative roles both within his home university and beyond. He continued with research on rainfall and water resources during that period, and introduced himself to a wider range of techniques that he could apply in future climatological work. And that was done in the final phase – much of it in a flowering of research papers when he was newly-retired from first administrative and then teaching responsibilities.

Stan Gregory never claimed credit for those changes, though he was clearly one of the successful 'revolutionaries'. Indeed, although he was President of both the Institute of British Geographers and the Geographical Association, as well as Section E of the British Association, his achievements never received recognition as widespread as they deserved. He received the Royal Geographical Society's Murchison Award in 1984 for 'contributions to climatology and quantitative geography' but was never awarded one of the Society's medals – although he did get the Royal Meteorological Society's Hugh Robert Mill Medal and Prize in 1990 for 'work over four decades concerned with the spatial and temporal properties of precipitation'.

The Geographical Association did recognise Stan's pioneering efforts, however, when it made him an Honorary Member in 1991 'in recognition of outstanding contributions to geographical education'. It was a career-long commitment. Stan believed that the rigour associated with the correct use of quantitative methods was necessary if the discipline was to be respected among the sciences and social sciences, and that the foundation for this rigour had to be instilled in the schools as well as the universities. He did much in the 1950s, 1960s and 1970s to ensure that happened, exemplified not only by his own climatological research but also his determination that 'our students' can cope with the quantitative revolution, not just 'the brightest or most precocious ones, but *all* of them' (Gregory, 1976e, 399: his emphasis); not to do so, he concluded, would be 'an abdication of our academic responsibilities', something that his distinguished career showed he never did.

[6] On ALCAB see https://www.theguardian.com/education/2013/jun/14/universities-deal-dfe-a-levels - accessed 7 July 2017. Its report on geography report, giving the members' names and affiliations, is available at https://alevelcontent.files. wordpress.com/2014/07/alcab-report-of-panel-on-geography-july-2014.pdf; on the role for quantitative analysis see Richard Harris's *A Short Introduction to Quantitative Geography* (https://www.rgs.org/NR /rdonlyres/46EB70CA-5508-4FB6-9629-ECD718CDCB83/0/ AShortIntroductiontoQuantitativeGeography.pdf – accessed 7 July 2017) produced for the RGS, and Harris (2016).

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1989b ‘The changing frequency of drought in India, 1871-1985’, *The Geographical Journal* 155, 322-334.
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1991b ‘Climatology and society’, *Interdisciplinary Science Reviews* 16, 24-30.
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1992b ‘Patterns and intensities of marked rainfall-deficit conditions in the State of Maharashtra, India, during the summer June-September monsoon, 1871-1984’, *Transactions of the Institute of Indian Geographers* 13, 1-27.
1993 ‘A hundred years of temperature and precipitation fluctuation at Sheffield, 1891-1990’, *Geography* 78, 241-249.

Chronology

1926	Born London, 28 February
1944-1947	Service in the Royal Navy
1950	Graduated Bachelor of Arts in Geography with First Class Honours, King's College London
1950	Appointed Assistant Lecturer, Department of Geography, University of Liverpool
1952	Awarded the degree of MA, University of Liverpool
1953	Promoted to Lecturer, Department of Geography, University of Liverpool
1958	Awarded the degree of PhD, University of Liverpool
1960-1961	Visiting Lecturer in Geography, University College of Sierra Leone, Freetown
1962	Promoted to Senior Lecturer, Department of Geography, University of Liverpool
1963	Published the first edition of *Statistical Methods and the Geographer*
1966	Promoted to Reader, Department of Geography, University of Liverpool
1968	Appointed Professor, Department of Geography, University of Sheffield
1968-1972	Joint Honorary Secretary, Geographical Association
1970	Commonwealth Fellow and Visiting Professor, Department of Geography, University of Ottawa
1973	Awarded Honorary Degree of DGeog, University of Ottawa
1975	President, Institute of British Geographers
1977-1978	President, Geographical Association
1978-1980	Dean, Faculty of Social Sciences, University of Sheffield
1980-1984	Pro-Vice-Chancellor, University of Sheffield
1984	Received the Murchison Award, Royal Geographical Society for 'contributions to climatology and quantitative geography'
1984-1988	Chair International Geographical Union Study Group on Recent Climatic Change
1988	Emeritus Professor of Geography, University of Sheffield
1988-1989	President, Section E of the British Association for the Advancement of Science
1990	Received the Hugh Robert Mill Medal and Prize of the Royal Meteorological Society for 'work over four decades concerned with the spatial and temporal properties of precipitation'
1991	Elected an Honorary Member of the Geographical Association 'in recognition of outstanding contributions to geographical education'
1993	Elected an Honorary Member of the Association of British Climatologists
2016	Died, Sheffield, 8 April